



California Regional Water Quality Control Board

Lahontan Region



Linda S. Adams
Secretary for
Environmental Protection

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Arnold Schwarzenegger
Governor

December 23, 2009

TO ALL INTERESTED PERSONS AND AGENCIES:

PROPOSED RESOLUTION TO SUPPORT A REQUEST FOR CLEANUP AND ABATEMENT ACCOUNT (CAA) FUNDS TO IMPLEMENT ASIAN CLAM CONTROLS IN LAKE TAHOE

Enclosed is a proposed resolution supporting a request for Cleanup and Abatement Account (CAA) funds to implement Asian clam control projects in Lake Tahoe. The California Regional Water Quality Control Board, Lahontan Region (Lahontan Water Board) anticipates considering the resolution for adoption at its February 2010 Board Meeting.

If approved, the resolution will demonstrate that the Lahontan Water Board supports an authorization by the State Water Resources Control Board (State Board) to release funds from the Cleanup and Abatement Account (CAA) to fund Asian clam eradication efforts in the amount of \$987,713. The approval of this resolution does not in itself authorize the release of CAA funds. If the resolution is approved by the Lahontan Water Board it will become part of a CAA fund request application to the State Board for the fund release authorization. The State Board will consider the request at a future State Board Meeting. The State Board may authorize CAA fund release in the amount requested, in an alternative amount, or not at all.

We request you review the enclosed documents and provide us with your written comments no later than **January 25, 2010**. Comments received after that date cannot be given full consideration in preparation of the resolution to be presented to the Board for adoption. It is proposed to present these requirements to the Lahontan Water Board for adoption at its meeting set for February 10 and 11, 2010 in South Lake Tahoe, California.

You may contact me at (530) 542-5466 if you should have any questions or wish to discuss the resolution language.

Daniel Sussman
Environmental Scientist

Enclosure

California Environmental Protection Agency

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....NOTICE....

Submittal of Written Material for Regional Board Consideration

In order to ensure that the Regional Board has the opportunity to fully study and consider written material, it is necessary to submit it at least ten (10) days before the meeting. This will allow distribution of material to the Board Members in advance of the meeting. Pursuant to Title 23 California Code of Regulations Section 648.4, the Regional Board may refuse to admit written testimony into evidence unless the proponent can demonstrate why he or she was unable to submit the material on time or that compliance with the deadline would otherwise create a hardship. If any other party demonstrates prejudice resulting from admission of the written testimony, the Regional Board may refuse to admit it.

A copy of the procedures governing Regional Water Board meetings may be found at Title 23, California Code of Regulations, Section 647 et seq., and is available upon request. Hearings before the Regional Board are not conducted pursuant to Government Code Section 11500 et seq.

Complete Form and Return

TO: California Regional Water Quality Control Board, Lahontan Region

SUBJECT: Comments on proposed resolution supporting a request for Cleanup and Abatement Account (CAA) funds to implement Asian clam control projects in Lake Tahoe.

- ☐ We concur with proposed resolution
☐ We concur; comments attached
☐ We do not concur; comments attached

(Sign)
(Type or print name)
(Organization)
(Address)
(City and State)
(Telephone)

California Environmental Protection Agency

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**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION**

RESOLUTION NO. R6T-2010 - (PROPOSED)

**REQUEST FOR CLEANUP AND ABATEMENT ACCOUNT FUNDS TO CONTROL
ASIAN CLAM INFESTATION IN LAKE TAHOE**

_____ El Dorado County _____

WHEREAS, the California Regional Water Quality Control Board, Lahontan Region (Lahontan Water Board), finds:

1. The primary responsibility for the protection of water quality in California rests with the State Water Resources Control Board and the nine Regional Water Quality Control Boards.
2. It is the responsibility of the Lahontan Water Board to regulate the activities and factors that affect or may affect the quality of waters of the region in order to achieve the highest water quality consistent with the maximum benefit to the people of the State.
3. The Water Quality Control Plan for the Lahontan Region (Basin Plan) was adopted in 1995. The Basin Plan identified the need to protect the surface and groundwaters of the Lake Tahoe Hydrologic Unit.
4. The non-native Asian clam (*Corbicula fluminea*) was detected in Lake Tahoe in 2002 and since then has expanded its infestation.
5. The Asian clam poses a threat to water quality and beneficial uses through transformation, concentration and excretion of high levels of bio-available nitrogen and phosphorus into the water column and sediment substrate. Asian clam colonies on the south east portion of Lake Tahoe contributed to blooms of filamentous algae in summer 2008. These algal blooms negatively affected the aesthetic enjoyment of Lake Tahoe. Additionally, decomposition of Asian clam shells increases localized calcium concentrations in the water column, creating a suitable habitat for potential establishment of aggressive Zebra and Quagga mussels.
6. Lahontan Water Board staff, as a participant in the Lake Tahoe Aquatic Invasive Species Coordinating Committee and the Asian Clam Working Group, supported a report, *Development of Asian Clam Control and Monitoring Plan Strategies for Lake Tahoe* (Attachment A). The report, completed in fall 2008, includes a four part management plan: I) Field testing of removal options and identification of science needs, II) Evaluation of a recommended strategy for Asian clam control, III) Implementation of the control strategy, and IV) Long-term monitoring to evaluate success.

7. On March 9, 2009, the State Water Resources Control Board authorized an urgency request of \$100,000 from Cleanup and Abatement Account funds to supplement \$303,248 from other agencies to implement an Asian clam removal pilot project in Lake Tahoe. The Asian clam removal pilot project is Part I.a. of the four part management plan. California's Tahoe Resource Conservation District administers the pilot project.
8. On June 2, 2009, the State Water Resources Control Board authorized an additional \$100,000 in Cleanup and Abatement Account funds to implement an Asian clam survey of Lake Tahoe. The lakewide survey used an autonomous underwater vehicle to determine the extent of the Asian clam infestation, including deepwater surveys where SCUBA divers cannot travel. The UC Davis Tahoe Environmental Research Center administers the project in collaboration with researchers from the University of British Columbia. The Nevada Division of State Lands authorized \$20,000 to fund collaboration with researchers from the University of Nevada, Reno to implement the survey project. The lakewide survey for Asian clam infestation is Part I.b.i. of the four part management plan. Data from the survey effort is undergoing post-processing, but initial reports indicate that previously unknown populations of Asian clams were found, including the presence of clams at depths of 80 meters.
9. The pilot clam removal project and the lakewide Asian clam survey are both included in Part I of the Asian clam management plan. Findings from the pilot project and survey are necessary to conduct Part II of the clam management plan. The final report on the pilot project is anticipated in February 2010. The completion of the survey report is anticipated July 2010, with preliminary data assembled in February 2010. Actions taken in Part III and Part IV of this plan are contingent on findings from Parts I and.
10. The Lahontan Water Board requests that State Board authorize \$987,713 from the Cleanup and Abatement Account to implement three Asian clam control projects, pursuant to Parts III.a. and III.e. of the four part Asian clam management plan. Project costs for the three projects, to be conducted in the 2010/2011, and 2012 field seasons, total \$1,230,713 (Attachment B). The Lahontan Water Board does not anticipate further requests for Asian clam funding during the following three years. The requested funds will be combined with \$243,000 in Southern Nevada Public Lands Management Act (SNPLMA) money from the US Fish and Wildlife Service to meet the project budget. The project will be administered by the Tahoe Regional Planning Agency. Budget tracking and compliance monitoring needs will be funded with a portion of the US Fish and Wildlife Service contribution.
11. Requested funds are in addition to previous money spent on Part I of the Asian clam management plan. Previous funding for Part I is detailed in Table 1.

Table 1. Funding contributed for previous projects in accordance with the Asian clam management plan.

	Pilot Eradication	Lakewide Survey	Total
State Board CAA	\$100,000	\$100,000	\$200,000
US FWS	\$145,495		\$145,495
US Bureau of Reclamation	\$8,000		\$8,000
Nevada State Lands	\$150,000	\$20,000	\$170,000
Total	\$403,495	\$120,000	\$523,495

In addition, the Asian Clam Working Group members have submitted requests for further SNPLMA funds to aid Parts II and III of the Asian clam management plan. Review of these requests is not complete. The SNPLMA requests are detailed in Table 2.

Table 2. Outstanding SNPLMA requests for Asian clam projects.

SNPLMA Round	Requested	Purpose	Estimated project completion date
Round 10 Science	\$77,000	Marla Bay Monitoring	June 2010
Round 10 Science	\$15,000	Reporting	November 2010
Round 11 Capital	\$310,000	Emerald Bay Eradication	Summer 2011
Round 11 Capital	\$200,000	Deep Water Ecology	Fall 2011

12. In the 2010 field season the Asian Clam Working Group proposes to spend \$148,602 of the CAA funds, if approved by State Board by April 2010) with \$243,000 of US Fish and Wildlife Service funds to implement a one acre project scale eradication project in the Marla Bay region. It is necessary to implement this project in May 2009 to take advantage of warm water conditions and a calm lake. Installation prior to the busy boating season will help ensure diver safety. This project will demonstrate the large scale efficacy of the bottom barrier eradication technique. Lessons learned, with respect to deployment logistics and large scale clam mortality effectiveness will be applied to subsequent projects.
13. The Asian Clam Working Group plans to implement clam eradication in Emerald Bay during the 2011 field season. Asian clams were discovered in the bay in summer 2009. Emerald Bay presents several logistical challenges to the implementation of the bottom barrier method. These include a sloped and irregular lake bottom, and high boat traffic. Due to these challenges, the cost to implement an eradication project in Emerald Bay is \$521,263. The clam infestation, mapped by SCUBA survey in September 2009, is of relatively low density, but does extend into the entrance channel to the bay. The area of infestation is approximately one acre. Lessons learned from the

2010 field season will be applied to overcome these challenges. The high cost of this proposed project is associated with challenges related to the project site. These challenges include a heterogenous and sloped lake bed, and implementing in the entrance and boating channel of Emerald Bay.

14. Part II of the four part management plan employs an expert panel to evaluate the management strategy for Asian clams. The panel, to be convened in early spring 2010, will evaluate the pilot level technique and project level eradication performance, as well as the state of infestation determined by the lakewide clam survey. The remaining \$317,848 being requested will be disbursed, pursuant to this management strategy, to implement a one acre eradication project anticipated for the 2012 field season. This implementation is expected to cost less than the other proposed projects because of decreased labor costs associated with an increase in implementation efficiency and a decrease in indirect costs,
15. Under Water Code section 13442, upon application by a public agency, such as the Lahontan Water Board, with authority to clean up a waste or abate the effects thereof, the State Water Resources Control Board may order moneys to be paid from the account of the public agency to assist it in cleaning up the waste or abating its effects on waters of the state.
16. The Lahontan Water Board considered all comments received at its regular meeting held on February 10, 2010 in South Lake Tahoe, California.

THEREFORE BE IT RESOLVED:

The Lahontan Water Board requests the State Water Resources Control Board allocate funds from the Cleanup and Abatement Account to the Lahontan Water Board in the amount of \$987,713. These funds will be used to implement Asian clam eradication actions at Lake Tahoe as described in this resolution.

I, Harold J. Singer, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of a Resolution adopted by the California Regional Water Quality Control Board, Lahontan Region, on February 10, 2010.

HAROLD J. SINGER
EXECUTIVE OFFICER

Attachments: A: *Development of Asian Clam Control and Monitoring Plan Strategies for Lake Tahoe*
 B: *Budget for Asian Clam Control 2010, 2011, 2012*

**DEVELOPMENT OF ASIAN CLAM CONTROL AND MONITORING PLAN STRATEGIES
FOR LAKE TAHOE**

Report submitted to

Tahoe Regional Planning Agency

and the

Lake Tahoe Aquatic Invasive Species Working Group

from

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⁶Lahontan Regional Water Quality Control Board

⁷Nevada Department of Wildlife

⁸Nevada Division of State Lands

⁹California State Lands Commission

¹⁰California State Parks

A. INTRODUCTION

Asian clam (*Corbicula fluminea*) is a non-native freshwater bivalve that has established in Lake Tahoe and is causing apparent associated environmental impacts. It has been observed in Lake Tahoe at very low densities since 2002, but recently (April 2008) populations have been discovered in much higher (50-3000 clams m⁻²) but patchy densities in the southern (CA-NV) portion of the lake. Members from Universities of California- Davis and Nevada- Reno (UCD and UNR respectively) conducted exploratory research since the discovery of the increased Asian clam populations in April 2008. University researchers and agency staff from the Tahoe Regional Planning Agency (TRPA), Tahoe Resource Conservation District TRCD, U.S. Fish and Wildlife Service (USFWS) and the Lahontan Regional Water Quality Control Board (LRWQCB) recently formed a working group to prioritize research, monitoring, and control projects of Asian clam populations in Lake Tahoe. The objective of this document is to provide **the full suite of research needs as called for by a complete science plan** with regard to Asian clam management. In this context, research includes scientific information related to Asian clams as well as information related to the logistics of the *in situ* field removal operations. The amount of funding available will determine the prioritization of the proposed research below. To date, we have \$100,000 committed from U.S. Fish and Wildlife Service, \$100,000 from the emergency clean up and abatement funds from Lahontan Regional Water Quality Control Board, and \$125,000 from the Nevada Division of State Lands. This sum allows us to immediately begin project work as enumerated below in Part 1a only—which includes pilot testing and research of removal and abatement techniques. This work is scheduled to begin in February 2009. Additional funds are needed to complete remaining tasks in 2009, and also into 2010.

B. PROBLEM STATEMENT

Asian clam are known aggressive invaders that have significant environmental impacts. Through Lake Tahoe field surveys, laboratory experiments, and literature reviews conducted since April 2008, UCD and UNR researchers have found that Asian clam 1) excretes elevated levels of nitrogen and phosphorus into the water column and sediment substrate 2) filters high volumes of water, and 3) have a strong correlation to the growth of large, nuisance blooms of bottom-dwelling, filamentous algae in the shorezone. Potential impacts of exponential increases of this species include degraded water quality, decline of pelagic phytoplankton and zooplankton communities, disruption to Lake Tahoe sports fisheries, increased levels of calcium through the concentration of dead shell matter with a promotion of other regional exotic species (Quagga), and out-competing Tahoe's native benthic species such as the Montane Pea clam (*Pisidium* spp.) and the Ramshorn snail (Planorbidae). Given these potential impacts, there is increasing recognition to develop an effective control strategy of Asian clam populations, predicting their spread, as well as the prevention of future invasive species (e.g. quagga and zebra mussel, the spiny water flea, etc.) introduction and establishment.

It is important to note that there is no obvious, simple option that has been proven to control Asian clam at other locations, therefore, eradication of Asian clam in Lake Tahoe is unlikely. However, management aimed at minimizing Asian clam population growth and impact to Lake Tahoe may be feasible. Consequently, the strategy at Lake Tahoe must be undertaken within an adaptive management framework, wherein new knowledge is used to inform and update management decisions.

C. ASIAN CLAM MANAGEMENT PHASES

The framework that we have identified to design and implement a research-based, lake wide Asian clam management plan involves a four part program. This program includes the use of pilot project testing and re-testing in small isolated Asian clam infestations, observation and monitoring, and the use of this information to develop an informed long-term management strategy for Asian clam in Lake Tahoe. The four parts are: I) Field testing of removal options and identification of science needs, II) Evaluation of a recommended strategy for Asian clam control, III) Implementation of the control strategy, and IV) Long-term monitoring to evaluate success. **Actions taken in part III and part IV of this plan are contingent on findings from parts I and II given efficacy, timing and costs associated with pilot projects and internal and external reviews.** The steps with each part are outlined below.

There are currently three mechanical management operations under consideration for pilot testing: 1) diver assisted suction removal (to physically remove clams from lake sediments), 2) bottom barriers, or large impermeable sheets to cover and kill Asian clam populations by reducing oxygen and food availability—and 3) some combination of the two treatments. These management options were selected because of their non-chemical nature, their previous use in Lake Tahoe to treat Eurasian watermilfoil and Curly leaf pondweed. Diver assisted suction removal is not practical for removal of clams from extensive areas, as the depth of clam habitat (4 inches) will require the removal of too much material from the lake bed. This technique may, however, be useful for removing small patches of clams. Diver assisted suction may have greater use in removing surface deposits of dead clam shells. Pilot testing of diver assisted suction will therefore focus on removal of small patches and removal of surface deposits. Barriers are currently believed to hold the greatest potential for controlling clams in areas where they are present over large areas (acres). The focus of the pilot testing will be to determine the minimum length of time for which barriers need to be in place to kill clams by depletion of oxygen

and/or food supply, and methods for efficiently installing large areas of barrier material (hundreds of square meters).

There are five points of evaluation related to efficacy of the field pilot tests: 1) Does the use of diver assisted suction removal and/or bottom barrier installation and removal cause nearshore turbidity requirement to exceed minimum levels as defined by the regulatory agencies?, 2) What are the impact of the respective management strategies on the physical removal or mortality rates of live clam beds? 3) Does diver assisted suction dredging effectively remove surficial shell matter, thus reducing localized calcium sinks? 4) What is the logistical capability of the action, i.e., what is the rate of removal per unit area per unit effort? And 5) What are the long term consequences of the management action? Once the efficacy of the small scale pilot removal efforts has been evaluated, these or other management options will be assessed for the possible implementation at a larger scale (i.e., multi-acre and/or whole lake treatment). A detailed work plan for Part I will be developed prior to the commencement of pilot operations as part of the permitting process. This work plan will, however, be adaptive in nature and designed to be modified as the testing proceeds.

Additionally, the use of natural, mild molluscicides (e.g. potassium) will be explored as a non-mechanical option **in the laboratory** as a possible long-term control option. These experiments are to test the concentrations required for effective yet environmentally safe use in the field, as well as to collect information that will be critical to inform the approval process for use in Lake Tahoe.

Part I – Field Testing of Removal Options and Identification of Science Needs

Part I of the Lake Tahoe Asian clam management plan is to 1) evaluate the technical feasibility, application logistics and cost for the various control options, 2) determine specific monitoring and management needs, 3) assess the

feasibility for Asian clam control using pilot test plots (<1 acre), and 4) perform a quantitative analysis of efficacy of control methods. Part I is designed to inform the management and research team for longer term control and monitoring options. These actions are an assessment necessary to determine likelihood of success and strategy before whole-lake implementation occurs. At this time we anticipate actions to include:

a. Design and implementation of pilot removal operations

- Selection and implementation of areas to test diver assisted suction removal and bottom barriers. This includes the installation of silt curtains to minimize the impacts of increased sediment resuspension as well as the possibility for juvenile spread during the pilot stage
- Evaluate the ability of screens/sieves within the waste collection system to remove small (young) clams
- Determination of proper suction removal equipment required to operate effectively at Lake Tahoe
- Determination of most effective means of providing diver air (compressed air tanks or surface diver air compressor)
- Development of diver safety procedures including back-up diver(s), safety officer and emergency equipment
- Establish minimum equipment (boat, barge, hoist, clam/vegetation disposal) requirements for winter operation
- Establish minimum weather conditions for safe and effective removal operation
- Determine waste (clams etc.) disposal site
- Determine most efficient bottom barrier size, handling and material
- Establish maximum water depth for diver operations

b. Monitoring program to assess:

- Efficacy of the control technique in pilot areas— includes immediate monitoring of clam populations to quantify the removal effort by suction removal, barriers, etc. This will be based on number of clams removed, number remaining, dredge size selectivity, assessment of clam mortality.
 - Impacts to lake water during operations (including the fate of dredge return water), changes to bottom substrate
 - Recolonization of sites, colonization of new sites, and release of juveniles during treatment
 - Asian clam population changes--Areal expansion, biomass growth and changing population densities in existing (non-treatment area) beds, includes impacts or suction removal on reproductive biology (release of juveniles into water)
 - Environmental impacts as a result of Asian clam control— includes changes in nutrient flux, turbidity, dissolved oxygen, and benthic disturbance
 - Efficacy of large scale removal, including water depth, acreage, disposal of large amounts (weight and mass) and personnel
- c. Clam bed expansion from existing beds, lake wide distribution, development of novel technology
- We currently have an incomplete understanding of the rate of expansion of existing beds and their lake wide distribution (only aware of populations from Zephyr Cove to Pope Beach—west, north shores have not been surveyed). An understanding of lake wide distribution and their growth is critical to determine strategies for lake-wide control.
 - Field testing of remote sensing technologies (such as sonar, high resolution photographic surveys by autonomous underwater vehicles, airborne lidar etc.) as a tool to rapidly assess large areas of the lake for the presence of clams. Such technologies are used elsewhere to detect fish egg masses and other biota in sediments; could provide a rapid and

effective means to survey for Asian clam presence on a large scale. If initial field tests determine that this survey method is effective, then a lake wide survey would be conducted. This will inform (f) below.

d. Clam population growth rate, food utilization, development of a growth model

- Understanding basic life history and clam energetics will be critical to determine the variability in their growth rates around the lake. We will quantify growth in existing patches and determine constraints (food, temperature, light, etc.) that may or may not be limiting their growth.

e. Habitat suitability of lake wide area

- A comprehensive, bottom sediment survey of environmental conditions has never been completed for the lake. This will be needed in order to assess which locations may establish clam populations.

f. Lake wide impacts at current or enhanced levels

- Impacts to the lake's ecology are unknown and likely vary based on the density of clams in a given locations. Changes to the open water (phytoplankton, clarity) and benthic communities are expected and could alter native fisheries. We will assess the potential for changes in clams of varying patch size.
- Impacts to drinking water systems--evaluation of nutrient or particle additions as a result of biofouling at intake pipes, possible impacts to non-filtration status (communications via Tahoe Water Suppliers Association (TWSA))

g. Facilitation by clams of other invasive species (e.g. quagga mussel) via the release of calcium from dead clam matter.

h. Laboratory testing of molluscicide treatments (effective dosages, impacts to clams, water quality, etc.)

i. Permitting, RFPs and funding (to be done by AIS)

- Permits will need to be written for the project by TRPA. TRPA staff within the Environmental Improvement Branch would be the lead planner for this permitting effort¹.

j. Outreach and education (see Section V)

Part II – Evaluation of a Management Strategy for Asian Clam Control

Once the pilot testing has been completed and efficacy and environmental impact have been reviewed, a preferred management strategy for Asian clam control can be selected. This process can include multiple (2-3) pilot test periods. This selection process includes input from the Lake Tahoe Asian clam management and research team, project stakeholders, and external reviewers:

- a. Economic evaluation of lake wide management strategy
- b. Report on the efficacy of pilot testing
- c. Summary of all scientific findings to date
- d. Lake Tahoe Asian clam work group and an external review panel will be convened to evaluate the potential based on the latest scientific information to determine the efficacy of removal strategies and effort. Information will be based on pilot test plot information, lake wide distribution, and information gathered to date.
- e. Report on recommendation strategy and timetable for clam control
- f. Evaluation of funding sources
- g. Public and agency outreach

¹ The Asian clam management working group is currently working on permit issues. In addition to the members represented on this document, we will invite representatives from the CA State Lands Commission as well as California State Parks to ensure proper permitting.

Part III – Implementation of expanded demonstration and/or lake-wide control actions

Upon completion of Parts I & II, the Asian clam control and monitoring project could progress in one of two directions: a) the implementation of an expanded demonstration (larger than pilot test plots but at a smaller scale than whole-lake effort) of possible control strategies, or b) the implementation of the large scale, lake wide control plan. The selection of option a or b will be determined by the evaluation of economic and environmental cost in the pilot testing periods of phase 1 and 2, assessment by the external and internal review panels, and feasibility of implementation given timing (i.e., winter periods to minimize impact of Asian clam reproductive cycle, high frequency recreational boating periods, etc.). Phase 3a or phase 3b should occur at a time to minimize the impact of Asian clam reproductive biology on the success of the management strategy, and should include an important public and agency outreach and communication scheme. This cannot be implemented until feasibility of management strategy and lake-wide distributional data have been determined.

- a. Implementation of recommended control strategies
- b. Onsite monitoring of existing locations
- c. Continued monitoring of control patches to determine recolonization, new colonization, benthic conditions, and water quality initiated in Part I.
- d. Finalize research recommended from peer review panel.
- e. Evaluation of efficacy of expanded demonstration/ lake wide control
- f. External peer review panel to evaluate progress and recommendations

Part IV – Long-term Monitoring to evaluate success

To understand the impact of control strategies, a long term monitoring plan must be employed. This will include the observation and evaluation of:

- a. Recolonization of Asian clam in areas where control strategies have been implemented
 - Growth and population level changes both within and without management areas
 - Includes both localized and lake wide survey
- b. Sediment characteristics
 - Changes to benthic areas as a result of Asian clam presence or removal (nutrient content, anoxia, calcium levels, etc.)
- c. Colonization in novel, uncolonized areas

Water quality conditions including benthic and pelagic habitats, ties to stormwater, Asian clam related algal blooms

D. Timeline and Related Costs

The following section outlines a timeline related to cost estimates and detailed actions, as well as a public outreach and interagency communication plan for the four phase Asian clam management plan. It is important to recognize that funding availability can affect the priority of needs outlined in Parts I-IV above, and detailed in the table below. Our intent was to provide **the full suite of research needs as called for by a complete science plan**. The table in this section shows the phase schedule with details related to actions, items, and where funds have been applied from (SNPLMA and Nevada Division of State Lands Tahoe License Plate Round 12), and suggestions for where needed funding may come from (SNPLMA capital funds [Capital] and LRWQCB request

for urgency funds from the State Water Resources Control Board Clean up and Abatement Account (Abatement)). This table does not include funds already spent or research actions already completed.

TABLE 1. COST BREAKDOWN FOR FIVE YEAR PROJECT (PART 1, 2 AND 3 ARE TWO YEARS, PART 4 IS APPROXIMATELY 5 YEARS)

(Yellow highlighting indicates PART total with breakdown following)

ITEM	TIME SCHEDULE	COST
PART 1. Initial Management Response and Related Science and Monitoring Needs	November 2008-November 2010	\$1,398,400
a. Initial Management Response	November 2008-December 2009	\$382,000
i. Design pilot removal operations <ul style="list-style-type: none"> • Suction removal • Bottom barriers 		\$19,700 ²
ii. Conduct pilot removal operations <ul style="list-style-type: none"> • Operation costs • Equipment costs • Project management 		\$90,000 \$35,000 \$20,000
iii. Monitoring <ul style="list-style-type: none"> • Success of field removal operations • Immediate removal effectiveness • Impacts to lake water during operations • Change in bottom substrate condition following treatment • Survey for recolonization of <i>Corbicula</i>, other invasive species and/or native species following treatment • Release/survivorship of juveniles during treatment <p>Operation costs (LAB CHEM COSTS 125 SAMPLES @ \$150 each, boat time 50 hours@200,3000, supplies, computing, etc.)</p> <p>LAB OPERATIONS (UCD AND UNR)</p>		\$18,200 \$21,800 \$20,000 \$18,200 \$48,000 \$9,000 \$31,800 \$20,000
iv. Public outreach		\$2,600
v. Agency coordination		\$2,600
vi. Project administration		\$11,200
vii. Reporting		\$13,900

² These funds to come from remaining Bureau of Reclamation funding, granted to UC Davis and UNR May 2008

b. Science Needs for Decision-Making and to Develop an Informed Management Plan ³	November 2008 – November 2010	\$1,016,400
i. Distribution and location <ul style="list-style-type: none"> • Development/field testing of remote sensing techniques • Completion of distribution analysis for the southeast/south shores • Depth of clam burial in sediment • Lake-wide survey Operating costs including boat time (120 hours at \$200 per hour), travel costs, bottles, etc., lab house in Incline (7.5 month at \$1500 per month) Lake-wide survey remote sensing costs (Subject to field testing (side scan sonar, AUV, alternative technologies.: includes instrument field survey time, post-processing data analysis)		\$14,800 \$47,600 \$11,100 \$75,800 \$38,300 \$130,000
ii. Characterization of <i>Corbicula</i> population growth <ul style="list-style-type: none"> • Clam bed range expansion monitoring • <i>Corbicula</i> fecundity/reproductive cycles and growth study • Determine rates of food usage (from both open water and sediment sources) and quantify how food available regulates growth and reproduction • Development of growth model based on food resources, water temperature, calcium concentrations, UV light conditions, etc. 		\$16,300 \$19,700 \$25,400 \$21,000
iii. Habitat suitability of lake wide area <ul style="list-style-type: none"> • Bottom substrate characterization (e.g. organic content, pore water chemistry, particle size distribution, macro-topography) • Surface current transport and wave action modeling 		\$24,200 \$96,000

³ Scientific understanding of the Asian clam (*Corbicula*) in Lake Tahoe is currently inadequate to inform resource agencies and decision-makers in the Lake Tahoe Basin with a management plan for this invader that contains a reliable risk assessment for the various levels of treatment available. Since the time scale for the growth and development of these biological populations is on the order of many months to years, it is only reasonable that the important science needs be initiated as early in this program as possible to ensure that future management actions is guided by more a more complete understanding. The results of the recommended research and monitoring will be used throughout all parts of the management effort including immediate (year 1 – development of control approach), intermediate (years 2-3-implementation of control actions), and future (years four and beyond –evaluation of success and adaptive management).

<ul style="list-style-type: none"> • Environmental parameters related to establishment and growth (e.g. UV light, temperature, wave action) 		Attachment A \$45,200
Funds for Jim Oris for UV Project		\$50,000
Operating costs (includes boat time (45 hours at \$200/hour), car travel, supplies @\$8000)		\$19,000
iv. Lake-wide impacts from current or enhanced levels of <i>Corbicula</i> <ul style="list-style-type: none"> • Localized stimulation of nuisance blooms of benthic algae • Impacts to in-lake phytoplankton, zooplankton, nutrients and lake clarity • Impacts on native benthic organisms 		\$34,500
Operating costs (bottles, 1 freezer, 1 incubation chamber, beakers, bags, sugar, boat time 50 hours @ \$200/hour)		\$42,800
v. Facilitated invasion of quagga mussels via calcium release from dead clam shells <ul style="list-style-type: none"> • Laboratory testing of survival, growth and reproduction using quagga mussels • Clam shell leaching experiments • Field sampling of lake water in direct contact with <i>Corbicula</i> • Assess need for shell removal following bottom barrier 		\$20,400
Operating costs includes boat time (36 hours at \$200/hour), car travel, and supplies		\$17,000
LAB OPERATIONS (UCD AND UNR)		\$13,900
vi. Laboratory molluscicide testing and evaluation		\$16,100
vii. Science coordination		\$17,100
viii. Public outreach		\$28,200
ix. Agency coordination		\$16,000
x. Scientific project administration		\$20,000
xi. Reporting		\$20,000
PART 2. Evaluation of Strategy for Asian Clam Control⁴	July 2009 – October 2009	\$172,400

⁴ During this part of the management plan basin agencies, together with the in-basin science team and an external peer panel, selected because of their knowledge of *Corbicula* ecology and management, will use the existing information and risk assessment to

i. Economic evaluation for lake-wide management strategy		\$30,000
ii. Preparation/participation and technical assessment by external peer review panel		\$55,400
Panel costs		\$40,000
iii. Report on Recommended Strategy and Timetable for <i>Corbicula</i> Control in Lake Tahoe ⁵		\$33,800
iv. Public Outreach		\$2,600
v. Agency coordination		\$2,600
vi. Project administration		\$10,600
PART 3. Implementation of Expanded Demonstration and/or Lake-wide Control Actions	November 2009 – October 2011	TBD
i. Implementation of recommended control strategy either at an expanded demonstration scale in the beds located in the southeast portion of the Lake, or lake-wide as determined in Part 2		Cost estimate comes from economic report in part 2
ii. On-site monitoring during removal operations		\$74,800
LAB CHEMISTRY COST: 200 SAMPLES@\$150 each		\$30,000
iii. Continued monitoring of recolonization, new colonization, benthic condition, and water quality status initiated in Part 1		\$141,600
iv. Finalize research as recommended in Part 1b		No Budget Associated (Part 1b)
v. Evaluation of efficacy of expanded demonstration/lake-wide control each year		\$44,200

determine the extent to which removal/control actions will be taken during the winter of 2009-2010. Tasks listed under Part 2 require the full completion of Part 1a and Part 1b to the extent possible.

⁵ Produced cooperatively by the LTAISWG (and associated agencies), in-basin science team and external peer review panel.

vi. Annually, assemble external peer review panel to evaluate progress and discuss future actions		\$14,500
Panel costs		\$50,000
vi. Public outreach		\$2,600
vii. Agency coordination		\$2,600
viii. Project administration		\$24,700
ix. Reporting		\$49,000

PART 4. Long-term Monitoring to Evaluate Success	November 2011 – annually into the future⁶	\$103,400
i. Survey for recolonization of <i>Corbicula</i> , other invasive species and/or native species in and adjacent to the treated areas		\$25,700
ii. Change in bottom substrate condition in treated areas		\$27,300
iii. Lake-wide survey for <i>Corbicula</i> in previously un-colonized areas		\$25,700
iv. Water quality conditions including pelagic and benthic habitats		\$10,000
vi. Public outreach		\$2,600
vii. Project administration		\$2,600
viii. Reporting		\$9,500

Table 2. Total amount requested from executive committee less other available funds **for initial two year period of proposed project (This includes Parts 1 and 2 ONLY)**

Amount requested and funding sources	Value
Total	\$1,398,400
Total minus in kind matching (UCD and UNR)	\$1,204,770
Total minus in kind matching and SNPLMA, NDSL funds (if granted)	\$803,196
Total minus in kind matching and SNPLMA, NDSL funds (if granted), and remainder BOR funds (\$23K)	\$780,196
Total minus in kind matching and SNPLMA, NDSL funds (if granted), and remainder BOR funds (\$23K) and Emergency funds (\$25K)	\$755,196
Total minus in kind matching and SNPLMA, NDSL funds (if granted), and remainder BOR funds (\$23K), Emergency funds (\$25K) and LRWQCB urgency requests from the State Water Board's Cleanup and Abatement Account (\$100K for urgent suction removal and up to \$100K additional urgent funds for research and monitoring). Requests >\$100K from Cleanup and Abatement Account require State Water Board approval and could take several months to approve.	\$655,196

⁶ It is expected that long-term monitoring for i-iii will be needed on an annual basis for at least five years following treatment.

Ibid minus NDSL contributed funds (\$125,000)	\$530,196
Ibid minus U.S. Fish and Wildlife SNPLMA Round 9 funds (\$100,000)	\$430,196

Attachment A

E. DEFINE WORKING GROUP AND PARTNER ROLES

The Asian clam working group combines a research team from UC Davis Tahoe Environmental Research Center (J. Reuter, G. Schladow, M. Wittmann) and University of Nevada Reno (S. Chandra) with a management team represented by members from the Tahoe Resource Conservation District (N. Cartwright and D. Roberts), the U.S. Fish and Wildlife Service (S. Chilton), the Lahontan Regional Water Quality Control Board (D. Smith), Tahoe Regional Planning Agency (T. Thayer, D. Oliver), Nevada Department of Wildlife (D. Catalano and K. Tisdale), Nevada Division of State Lands (E. Harrison). In the future, representatives from the California State Lands Commission and California State Parks will be involved in this project.

The research team (UNR & UCD) will provide scientific guidance and technical expertise regarding Asian clam biology, control and its relationship to the physical, chemical, and ecological properties of Lake Tahoe. UCD and UNR will conduct onsite monitoring and analysis of short and long term control treatments, field work including Asian clam presence/absence surveys, physical habitat characterizations, laboratory experimentation, and analysis of ecological data. As well as conducting the research described above, the research team may choose to collaborate with other research institutions when additional expertise is warranted.

The operations plan for Asian clam removal will be carried out cooperatively by U.S. FWS, TRPA, TRCD, and UCD and UNR. Initially TRPA will procure a diver-assisted suction removal unit and the TRCD will contract for the personnel and additional equipment required to facilitate the project. TRCD will also develop and implement a media and outreach plan. Specific locations in California and Nevada for the removal coinciding with research conducted by UCD and UNR will be determined and logistical considerations will be evaluated. Weather and contractor availability will determine the operational windows, but the project

will most likely proceed in January 2009 and continue for ten to twenty working days. Personnel will be contracted by the TRCD and will be under their contractual control. Suction removal equipment will be purchased and retained by TRPA and TRPA watercraft will be utilized during the operation. Project coordination will be facilitated by U.S. Fish and Wildlife Service (FWS).

Additionally, TRPA, in its role as the bi-state regulatory agency, will provide permitting for the project. The TRPA will also provide logistical support for the removal and monitoring effort, as well as assistance with public outreach and agency coordination. Lastly, the TRPA will work with state and federal agencies to provide funds for the project.

The role of the Nevada Division of State Lands (NDSL) in the Asian Clam Control and Monitoring Plan are several. The State of NV owns the lake bottom lakeward of elevation 6223.0 feet and therefore NDSL will need to provide temporary authorization for any work planned for pilot projects associated with Asian Clam control. The State of Nevada has a vested interest in assisting with Asian Clam control and therefore some financial assistance from NDSL will be provided for the pilot program. NDSL will assist in providing public outreach on these efforts where feasible and where resources are available. NDSL intends to provide authorization to another party to submit an application on behalf of NDSL to complete the clam removal work. It is expected that this party will be issued the TRPA permit rather than NDSL. NDSL will provide authorization for another party to complete the actual pilot activities on NDSL property.

NDOW will be able to provide limited on the ground assistance due to budget constraints and resources. NDOW can provide a barge (diver staging, material collection, etc.) if needed but will not have anyone available to man the vessel. In addition, the State of NV has a vested interest in assisting with the control of Asian Clam species and therefore will provide assistance when possible. NDOW

may be able to provide some outreach through the department webpage and conservation education program.

TRCD will manage outreach coordination with HOA's, presentations, development, etc. as specified in the table in section F. The TRCD will manage possible contracts, grants, and possibly permits. Finally, TRCD will assist in the coordination with agencies, CCC members, removal crews and scheduling related to removal pilot and demonstration projects.

LRWQCB will provide support for the project and request up to \$100K from the State Water Board Cleanup and Abatement Account funds for the urgent suction removal and bottom barrier pilot projects. Additionally, LRWQCB will review, comment, and provide active involvement if the group pursues basin plan amendment to use molluscicides in Lake Tahoe⁷.

⁷ Molluscicides tested herein falls under the California Agricultural Code § 12753 definition of a pesticide. All laboratory testing of molluscicides will be directed toward assessing the application of these pesticides so as to not exceed the lowest detectable levels, using the most recent detection procedures available, no increases in pesticide concentrations in bottom sediments or aquatic life. Waters designated as MUN shall not contain concentrations of pesticides or herbicides in excess of the limiting concentrations specified in Table 64444-A of Section 64444 (Organic Chemicals) of Title 22 of the California Code of Regulations which is incorporated by reference into this plan. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

F. COMMUNICATION SYSTEM

The management of Asian clam in Lake Tahoe will require a communication system whose goal to increase awareness of Asian clam presence, control and removal. The general objective is to reduce the public's negative response to clam removal and to keep agency representatives and other stakeholders informed of all actions taken. The table below summarizes means of communication and associated costs.

Objective	Target Audience	Message	Format	Distribution	Cost Estimate
Alert and increase awareness of removal plans to reduce negative response	Nearby property owners	<ul style="list-style-type: none"> Clam removal will occur on dates: XX Reasons for and possible impacts 	Printed mailer	US Postal Service	10 hrs TRCD= \$340 30 hrs AC= \$0 3 hours review TRPA= \$87.06
	Basin residents	" "	Press release	Newspaper	4 hrs TRCD= \$136 12 hrs AC 3 hrs TRPA=\$87.06
	Boaters	" " <ul style="list-style-type: none"> Check equipment for AIS 	<ul style="list-style-type: none"> Brochures Notifications at marinas and launch sites 	Hand out by watercraft inspectors, marina staff, postings at launches	4 hrs TRCD= \$136 12 hrs AC 3 hrs TRPA=\$87.06
	Visitors	AIS impact Lake Tahoe	Exhibits, posters	<ul style="list-style-type: none"> UC Davis Thomas J. Long Foundation Education Center Tahoe Maritime Museum Explore 	20 hrs TRCD= \$680 30 hrs AC 5 hrs TRPA=\$145.10

Objective	Target Audience	Message	Format	Distribution	Cost Estimate
				Tahoe	
Information sharing regarding control implementation	Agency staff	Removal updates	<ul style="list-style-type: none"> • PDF memo • Meetings 	<ul style="list-style-type: none"> • List serve (e.g. clamlist@ucdavis.edu) • Monthly meetings with agency participants to disseminate information 	25 hrs TRCD=\$850 10 hrs TRPA=\$290.20
	Tahoe Water Suppliers Association (TWSA)	Communication and meetings regarding water intakes, monitoring plans, biofouling, etc.	<ul style="list-style-type: none"> • Meetings, emails 	<ul style="list-style-type: none"> • Meetings with TWSA participants to disseminate information 	

Attachment B

Table 1. Marla Bay Implementation, 2010

Rubber implementation (For one acre of rubber in Southeast Lake Tahoe, Marla Bay Region)	Cost	Indirect cost (26% UCD)	Total (Indirect plus direct cost)
Labor—installation			
Test rolling out (underwater) with two 50' by 10' sheets (Brant, Marion, Daret, Bill)—2 days, boat time, dive time, fabrication, removal, decon	\$ 3,000	\$ 780	\$ 3,780
Rubber rolling out and prepping for field deployment at south shore site (2 hired laborers + truck rental)	\$ 2,600	\$ 676	\$ 3,276
Field delineation of rubber sites (Brant, Marion, Line)—two days of boat time + dive time + line	\$ 2,000	\$ 520	\$ 2,520
Truck transport from South shore site onto barge (2 hired laborers + gradeall forklift rental)	\$ 4,800	\$ 1,248	\$ 6,048
Dump rubber from barge to underwater site (Daret and Bill + Barge employees—salary costs below, barge employees included in barge fee)	\$ -	\$ -	\$ -
Arrange/ place rubber rolls underwater, secure, prep to be rolled out (2 days, 6 divers all day (3 hrs each in water), 4 in water at any 1 time)—hired diver rate: \$200/hour	\$ 19,200	\$ -	\$ 19,200
Rolling out rubber mats underwater (2 days, 6 divers all day (3 hours each in water), 4 in water at any 1 time)—hired diver rate: \$200/hour	\$ 19,200	\$ -	\$ 19,200
Cover edges and seams with rebar, other weights (2 days, 6 divers all day (3 hours each in water), 4 in water at any 1 time)—hired diver rate: \$200/hour	\$ 19,200	\$ -	\$ 19,200
Total	\$ 70,000	\$ 3,224	\$ 73,224
Labor—removal			
Total (Same as installation + \$10K for decontamination by TERC staff)	\$ 80,000	\$ 5,824	\$ 85,824
Materials—installation			
40 10' by 100' 45 mil EPDM bond liner	\$ 32,000	\$ -	\$ 32,000
2 1.25" pipe x 21'	\$ 400	\$ 104	\$ 504
20 2" PVCx 20 feet	\$ 300	\$ 78	\$ 378
210 rebar weights - #7 x 2'0"	\$ 700	\$ 182	\$ 882
10 floats/ airbags to move rubber rolls	\$ 1,500	\$ 390	\$ 1,890
8 pallets	\$ 800	\$ 208	\$ 1,008
4 rolling shafts	\$ 400	\$ 104	\$ 504
2 drive systems	\$ 2,000	\$ 520	\$ 2,520
10 rebar baskets	\$ 2,000	\$ 520	\$ 2,520
Airbags for moving rolls underwater (10)	\$ 2,000	\$ 520	\$ 2,520
Dive gear (UCD costs—air tank fills, rentals, misc dive gear, travel to Reno)	\$ 3,000	\$ 780	\$ 3,780
Total materials	\$ 45,100	\$ 3,406	\$ 48,506
Fabrication and installation and planning			
Bill Suis and Daret Kehlet (60 days)	\$ 29,382	\$ 7,639	\$ 37,021
Marion Wittmann (2 months)	\$ 9,880	\$ 2,569	\$ 12,449
TERC staff (Katie Webb 1 month)	\$ 4,420	\$ 1,149	\$ 5,569
Brant Allen (2 months)	\$ 13,000	\$ 3,380	\$ 16,380
Sudeep Chandra (0.5 months)	\$ 3,965	\$ 1,031	\$ 4,996
UNR staff (1 month)	\$ 4,420	\$ 1,149	\$ 5,569
John Reuter (0.5 months)	\$ 5,265	\$ 1,369	\$ 6,634
Geoff Schladow (0.5 months)	\$ 6,581	\$ 1,711	\$ 8,292
Total	\$ 76,913	\$ 19,997	\$ 96,911
Barge Time			
Deployment (9 days)	\$ 28,800	\$ -	\$ 28,800
Removal (12 days)	\$ 38,400	\$ -	\$ 38,400
Total Barge	\$ 67,200	\$ -	\$ 67,200
Travel	\$ 3,000	\$ 780	\$ 3,780
	Direct	Indirect	Total
Total Project Cost	\$ 342,213	\$ 33,231	\$ 375,445

Attachment B

Table 2. Emerald Bay Implementation, 2011

Rubber implementation (For one acre of rubber in Emerald Bay)	Cost	Indirect cost (26%UCD)	Total (Indirect plus direct cost)
Monitoring			
Ponar sampling pre-barrier application (1 time)	\$ 10,000	\$ 2,600	\$ 12,600
Ponar sampling post-barrier removal (once immediately afterwards and quarterly for 1 year period)	\$ 40,000	\$ 10,400	\$ 50,400
Total	\$ 50,000	\$ 13,000	\$ 63,000
Labor—installation			
Rubber rolling out and prepping for field deployment at south shore site (2 hired laborers + truck rental)	\$ 2,600	\$ 676	\$ 3,276
Field delineation of rubber sites (Brant, Marion, Line)—four days of boat time + dive time + line	\$ 4,000	\$ 1,040	\$ 5,040
Truck transport from South shore site onto barge (2 hired laborers + gradeall forklift rental)	\$ 4,800	\$ 1,248	\$ 6,048
Dump rubber from barge to underwater site (Daret and Bill + Barge employees—salary costs below, barge employees included in barge fee)	\$ -	\$ -	\$ -
Arrange/place rubber rolls underwater, secure, prep to be rolled out (2 days, 6 divers all day (3 hrs each in water), 4 in water at any 1 time)—hired diver rate: \$200/hour	\$ 19,200	\$ -	\$ 19,200
Rolling out rubber mats underwater (4 days, 6 divers all day (3 hours each in water), 4 in water at any 1 time)—hired diver rate: \$200/hour	\$ 38,400	\$ -	\$ 38,400
Cover edges and seams with rebar, other weights (4 days, 6 divers all day (3 hours each in water), 4 in water at any 1 time)—hired diver rate: \$200/hour	\$ 38,400	\$ -	\$ 38,400
Total	\$ 107,400	\$ 2,964	\$ 110,364
Labor—removal			
Total (Same as installation + \$10K for decontamination by TERC staff)	\$ 117,400	\$ 5,564	\$ 122,964
Materials—installation			
Dive gear (UCD costs—air tank fills, rentals, misc dive gear, travel to Reno)	\$ 3,000	\$ 780	\$ 3,780
Total materials	\$ 3,000	\$ 780	\$ 3,780
Fabrication and Installation and planning			
Bill Suis and Daret Kehlet (80 days)	\$ 29,382	\$ 7,639	\$ 37,021
Marion Wittmann (1.5 months)	\$ 7,410	\$ 1,927	\$ 9,337
TERC staff (Katie Webb 1 month)	\$ 4,420	\$ 1,149	\$ 5,569
Brant Allen (1 month)	\$ 6,500	\$ 1,690	\$ 8,190
Sudeep Chandra (0.5 months)	\$ 3,965	\$ 1,031	\$ 4,996
UNR staff (1 month)	\$ 4,420	\$ 1,149	\$ 5,569
John Reuter (0.5 months)	\$ 5,265	\$ 1,369	\$ 6,634
Geoff Schladow (0.5 months)	\$ 6,581	\$ 1,711	\$ 8,292
Total	\$ 67,943	\$ 17,665	\$ 85,608
Barge Time			
Deployment (14 days)	\$ 44,800	\$ -	\$ 44,800
Removal (15 days)	\$ 48,000	\$ -	\$ 48,000
Total Barge	\$ 92,800	\$ -	\$ 92,800
Travel	\$ 3,000	\$ 780	\$ 3,780
	Direct	Indirect	Total
Total Project Cost	\$ 441,543	\$ 40,753	\$ 482,296

Attachment B

Table 3. Site 3 Implementation, 2012. Site determined from strategy development and informed by successes of 2010 and 2011 projects

Rubber implementation (For one acre of rubber at an additional site (Glenbrook Bay))	Cost	Indirect cost (28% UCD)	Total (Indirect plus direct cost)
Labor—installation			
Test rolling out (underwater) with two 50' by 10' sheets (Brant, Marion, Daret, Bill)—2 days, boat time, dive time, fabrication, removal, decon	\$ 3,000	\$ 780	\$ 3,780
Rubber rolling out and prepping for field deployment at south shore site (2 hired laborers + truck rental)	\$ 2,600	\$ 676	\$ 3,276
Field delineation of rubber sites (Brant, Marion, Line)—two days of boat time + dive time + line	\$ 2,000	\$ 520	\$ 2,520
Truck transport from South shore site onto barge (2 hired laborers + gradeall forklift rental)	\$ 4,800	\$ 1,248	\$ 6,048
Dump rubber from barge to underwater site (Daret and Bill + Barge employees—salary costs below, barge employees included in barge fee)	\$ -	\$ -	\$ -
Arrange/place rubber rolls underwater, secure, prep to be rolled out (2 days, 6 divers all day (3 hrs each in water), 4 in water at any 1 time)—hired diver rate: \$200/hour	\$ 19,200	\$ -	\$ 19,200
Rolling out rubber mats underwater (2 days, 6 divers all day (3 hours each in water), 4 in water at any 1 time)—hired diver rate: \$200/hour	\$ 19,200	\$ -	\$ 19,200
Cover edges and seams with rebar, other weights (2 days, 6 divers all day (3 hours each in water), 4 in water at any 1 time)—hired diver rate: \$200/hour	\$ 19,200	\$ -	\$ 19,200
Total	\$ 70,000	\$ 3,224	\$ 73,224
Labor—removal			
Total (Same as installation + \$10K for decontamination by TERC staff)	\$ 80,000	\$ 5,824	\$ 85,824
Fabrication and installation and planning			
Bill Suis and Daret Kehlet (60 days)	\$ 29,382	\$ 7,639	\$ 37,021
Marion Wittmann (2 months)	\$ 9,880	\$ 2,569	\$ 12,449
TERC staff (Katie Webb 1 month)	\$ 4,420	\$ 1,149	\$ 5,569
Brant Allen (2 months)	\$ 13,000	\$ 3,380	\$ 16,380
Sudeep Chandra (0.5 months)	\$ 3,965	\$ 1,031	\$ 4,996
UNR staff (1 month)	\$ 4,420	\$ 1,149	\$ 5,569
John Reuter (0.5 months)	\$ 5,265	\$ 1,369	\$ 6,634
Geoff Schladow (0.5 months)	\$ 6,581	\$ 1,711	\$ 8,292
Total	\$ 76,913	\$ 19,997	\$ 96,911
Barge Time			
Deployment (9 days)	\$ 28,800	\$ -	\$ 28,800
Removal (12 days)	\$ 38,400	\$ -	\$ 38,400
Total Barge	\$ 67,200	\$ -	\$ 67,200
Travel	\$ 3,000	\$ 780	\$ 3,780
	Direct	Indirect	Total
Total Project Cost	\$ 297,113	\$ 29,825	\$ 326,938